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Superfund



# Risk Assessment Guidance for Superfund Volume I Human Health Evaluation Manual (Part A)

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## Interim Final



See also 4.5.3,  
pages 4-12 / 4-13

future. In these cases, it should be assumed that water could be drawn from directly adjacent to the source. Selection of the location(s) used to evaluate future ground-water exposures should be made in consultation with the RPM. Second, compare the construction of wells (e.g., drinking water wells) in the area with the construction of the monitoring wells. For example, drinking water wells may draw water from more than one aquifer, whereas individual monitoring wells are usually screened in a specific aquifer. In some cases it may be appropriate to separate data from two aquifers that have very limited hydraulic connection if drinking water wells in the area draw water from only one of them. Consult a hydrogeologist for assistance in the above considerations.

Another issue to consider is filtration of water samples. While filtration of ground-water samples provides useful information for understanding chemical transport within an aquifer (see Section 4.5.3 for more details), the use of filtered samples for estimating exposure is very controversial because these data may underestimate chemical concentrations in water from an unfiltered tap. Therefore, data from unfiltered samples should be used to estimate exposure concentrations. Consult with the RPM before using data from filtered samples.

Ground-water monitoring data are often of limited use for evaluating long-term exposure concentrations because they are generally representative of current site conditions and not long-term trends. Therefore, ground-water models may be needed to estimate exposure concentrations. Monitoring data should be used when possible to calibrate the models.

Estimating exposure concentrations in ground water using models can be a complex task because of the many physical and chemical processes that may affect transport and transformation in ground

water. Among the important mechanisms that should be considered when estimating exposure concentrations in ground water are leaching from the surface, advection (including infiltration, flow through the unsaturated zone, and flow with ground water), dispersion, sorption (including adsorption, desorption, and ion exchange), and transformation (including biological degradation, hydrolysis, oxidation, reduction, complexation, dissolution, and precipitation). Another consideration is that not all chemicals may be dissolved in water, but may be present instead in nonaqueous phases that float on top of ground water or sink to the bottom of the aquifer.

The proper selection and application of soil and ground-water models requires a thorough understanding of the physical, chemical, and hydrogeologic characteristics of the site. SEAM (EPA 1988b) provides a discussion of the factors controlling soil and ground-water contaminant migration as well as descriptions of various soil and ground-water models. For more in-depth guidance on the selection and application of appropriate ground-water models, consult *Selection Criteria for Mathematical Models Used in Exposure Assessments: Ground-water Models* (EPA 1988c). As with all modeling, the assessor should carefully evaluate the applicability of the model to the site being evaluated, and should consult with a hydrogeologist as necessary.

If ground-water modeling is not used, current concentrations can be used to represent future concentrations in ground water assuming steady-state conditions. This assumption should be noted in the exposure assessment chapter and in the uncertainties and conclusions of the risk assessment.

### 6.5.3 ESTIMATE EXPOSURE CONCENTRATIONS IN SOIL

Estimates of current exposure concentrations in soil can be based directly on summarized monitoring data if it is assumed that concentrations remain constant over time. Such an assumption may not be appropriate for some chemicals and some sites where leaching, volatilization, photolysis, biodegradation, wind erosion, and surface runoff will reduce chemical concentrations over time. Soil monitoring data and site conditions should be carefully screened to

**Depth of samples.** Sample depth should be applicable for the exposure pathways and contaminant transport routes of concern and should be chosen purposively within that depth interval. If a depth interval is chosen purposively, a random procedure to select a sampling point may be established. Assessment of surface exposures will be more certain if samples are collected from the shallowest depth that can be practically obtained, rather than, for example, zero to two feet. Subsurface soil samples are important, however, if soil disturbance is likely or if leaching of chemicals to ground water is of concern, or if the site has current or potential agricultural uses.

**Fate and transport properties.** The sampling plan should consider physical and chemical characteristics of soil that are important for evaluating fate and transport. For example, soil samples being collected to identify potential sources of ground-water contamination must be able to support models that estimate both quantities of chemicals leaching to ground water and the time needed for chemicals to leach to and within the ground water.

#### 4.5.3 GROUND WATER

Considerable expense and effort normally are required for the installation and development of monitoring wells and the collection of ground-water samples. Wells must not introduce foreign materials and must provide a representative hydraulic connection to the geologic formations of interest. In addition, ground-water samples need to be collected using an approach that adequately defines the contaminant plume with respect to potential exposure points. Existing potential exposure points (e.g., existing drinking water wells) should be sampled.

More detailed information concerning ground-water sampling considerations (e.g., sampling equipment, types, and techniques) can be found in the references in the box on this page. In addition to the general sampling considerations discussed previously in Section 4.5.1, those specific for ground water -- hydrogeologic properties, well location and depth, and filtered vs. unfiltered samples -- are discussed below.

#### GROUND-WATER SAMPLING GUIDANCE

*Practical Guide to Ground-water Sampling* (EPA 1983a)

*A Compendium of Superfund Field Operations Methods* (EPA 1987c)

*Handbook: Ground Water* (EPA 1987d)

*Statistical Methods for Evaluating Ground Water from Hazardous Waste Facilities* (EPA 1988b)

*Guidance on Remedial Actions for Contaminated Ground Water at Superfund Sites* (EPA 1988e)

*Ground-water Sampling for Metals Analyses* (EPA 1989d)

**Hydrogeologic properties.** The extent to which the hydrogeologic properties (e.g., hydraulic conductivity, porosity, bulk density, fraction organic carbon, productivity) of the aquifer(s) are characterized may have a significant effect on the risk assessment. The ability to estimate future exposure concentrations depends on the extent to which hydrogeologic properties needed to evaluate contaminant migration are quantified. Repetitive sampling of wells is necessary to obtain samples that are unaffected by drilling and well development and that accurately reflect hydrogeologic properties of the aquifer(s).

**Well location and depth.** The location of wells should be such that both the horizontal and vertical extent of contamination can be characterized. Separate water-bearing zones may have different aquifer classifications and uses and therefore may need to be evaluated separately in the risk assessment. In addition, sinking or floating layers of contamination may be present at different depths of the wells.

**Filtered vs. unfiltered samples.** Data from filtered and unfiltered ground-water samples are useful for evaluating chemical migration in ground water, because comparison of chemical

concentrations in unfiltered versus filtered samples can provide important information on the form in which a chemical exists in ground water. For instance, if the concentration of a chemical is much greater in unfiltered samples compared to filtered samples, it is likely that the majority of the chemical is sorbed onto particulate matter and not dissolved in the ground water. This information on the form of chemical (i.e., dissolved or suspended on particulate matter) is important to understanding chemical mobility within the aquifer.

If chemical analysis reveals significantly different concentrations in the filtered and unfiltered samples, try to determine whether there is a high concentration of suspended particles or if apparently high concentrations are due to sampling or well construction artifacts. Supplementary samples can be collected in a manner that will minimize the influence of these artifacts. In addition, consider the effects of the following.

- Filter size. A 0.45  $\mu\text{m}$  filter may screen out some potentially mobile particulates to which contaminants are absorbed and thus under-represent contaminant concentrations. (Recent research suggests that a 1.0  $\mu\text{m}$  may be a more appropriate filter size.)

Pumping velocity. Pumping at too high a rate will entrain particulates (to which contaminants are absorbed) that would not normally be mobile; this could overestimate contaminant concentrations.

- Sample oxidation. After contact with air, many metals oxidize and form insoluble compounds that may be filtered out; this may underestimate inorganic chemical concentrations.
- Well construction materials. Corrosion may elevate some metal concentrations even in stainless steel wells.

If unfiltered water is of potable quality, data from unfiltered water samples should be used to estimate exposure (see Chapter 6). The RPM should ultimately decide the type of samples that

are collected. If only one type of sample is collected (e.g., unfiltered), justification for not collecting the other type of sample (e.g., filtered) should be provided in the sampling plan.

#### 4.5.4 SURFACE WATER AND SEDIMENT

Samples need to be collected from any nearby surface water body potentially receiving discharge from the site. Samples are needed at a sufficient number of sampling points to characterize exposure pathways, and at potential discharge points to the water body to determine if the site (or some other source) is contributing to surface water/sediment contamination. Some important considerations for surface water/sediment sampling that may affect the risk assessment for various types and portions of water bodies (i.e., lotic waters, lentic waters, estuaries, sediments) are discussed below. More detailed information concerning surface water and sediment sampling, such as selecting sampling locations and sampling equipment, types, and techniques, is provided in the references given in the box below.

##### SURFACE WATER AND SEDIMENT SAMPLING GUIDANCE

*Procedures for Handling and Chemical Analysis of Sediment and Water Samples* (EPA and COE 1981)

*Sediment Sampling Quality Assurance User's Guide* (EPA 1984)

*Methods Manual for Bottom Sediment Sample Collection* (EPA 1985b)

*A Compendium of Superfund Field Operations Methods* (EPA 1987c)

*An Overview of Sediment Quality in the United States* (EPA 1987e)

*Proposed Guide for Sediment Collection, Storage, Characterization and Manipulation* (The American Society for Testing and Materials, undated)

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Bq source  
in proximity.  
Do not  
recommend  
using back-  
filled (0.45  $\mu\text{m}$ )